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AND

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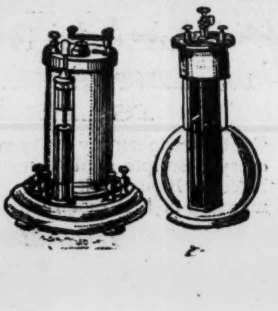

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THE TELEGRAPHIC JOURNAL.

VOL. VI.—NO. 118.

1877.

THE past year will probably come to be regarded in telegraphic annals as the year of the articulating telephone. Although the primitive form of this instrument was exhibited at the Centennial Exhibition at Philadelphia in 1875, it was not until 1877, that it was perfected to its present simple shape, and introduced to the world as a practical telegraphic appliance. Inspired by the enthusiastic verdict of the Centennial Exhibition Commissioners, who characterised his invention as "perhaps the greatest marvel hitherto achieved by the electric telegraph." Professor Graham Bell prosecuted his experiments, and on the 4th of May, 1877, exhibited the speaking telephone in its present pattern to a public assembly in the Boston Music-Hall, U.S. On this occasion, speaking and singing was transmitted with great ease between the hall and the town of Providence, 43 miles distant. During the rest of the year, a great variety of experiments were made to test the powers of the instrument. It was found possible to speak with facility through a resistance amounting to, at least, 12,000 ohms. The longest actual telegraph line as yet spoken through is that from Boston to New York, a distance of 250 miles. The first practical application of the telephone was made in May last year, by the Water Board of Cambridge, Massachusetts, who established telephonic communition with the waterworks under their control. It is stated that more than 500 houses in New England now employ the instrument, and that upwards of 3,000 are in operation in the United States. In this country, where considerable attention has been drawn to it by the visits and lectures of the inventor, there is at present a large demand for telephones, a demand which in all probability would be greatly multiplied were it not for the heavy royalty charged under the patent. In Germany, where there is no patent taken out, the sale of telephones is said to be extraordinary, and the German Government telegraph authorities have promptly adopted them into their system of working, as, indeed, the English postal authorities have also recently done.

The instrument from its nature must become useful in a thousand ways, and is not likely ever to become obselete. Mr. Bell's is as yet the paragon form, and from its extreme simplicity, appears likely to remain so. The feebleness of the sounds which it gives out is, however, its weak point; but it is hoped that this will be remedied in future. Already we hear that M. Trouvé of Paris, obtains more powerful undulatory currents by multiplying the diaphragms of the telephone, so that the vibrations of the voice are taken up by a number of similar vibrating surfaces instead of a single one, and produce a multiplied effect.

The articulating telephone of Mr. Thomas Alva Edison, the distinguished American electrician, followed hard on the back of Professor Bell's, and is said to yield louder sounds, although the articulation is not so perfect, and the apparatus is much more complicated. Its action is based on the discovery of Mr. Edison's, that plumbago has the property of diminishing in resistance under pressure in a degree proportionate to the pressure. This newly discovered property of plumbago promises to become a useful one in telegraphy. Mr. Edison has constructed a novel relay on the principle.

The invention of an apparatus by which it will be possible to graphically record speech at a distance, is a problem which naturally presents itself after the invention of an articulating telephone, and we were only recently informed, from America, that the problem has had a measure of promising success by the daring ingenuity of Mr. Edison. The phonograph, as the instrument for marking down the vibrations of speech is called, is an automatic reporter, such as was predicted by Sir Charles Wheatstone very early in his career, and not strictly a telegraphic instrument; but if used in conjunction with the articulating telephone it will become so, since it will then be possible to record speech at a distance by permanent marks. The most striking result of this invention, should it be perfected to the degree anticipated by the inventor, will be the power which it puts into our hands of storing up the past utterances of people and reproducing them by mechanical mimicry.

During the past year, in addition to the telephone, another practical contribution has been made to us from America, in the shape of Messrs. Prescott and Edison's Quadruplex System of working. The introduction of this system on the London to Liverpool circuit of the postal telegraphs, has been an unquestionable success.

The duplex system of working, by means of Muirhead's artificial lines, has been applied to two very long cables. In the spring, the duplex balance was set up on the Aden to Bombay Cable of the Eastern Telegraph Company, and at the end of the year, the balance was obtained on the direct United States Cable from Ballinskellig's Bay to Torbay. These successes, of native origin, in the difficult province of submarine duplex work, have not been brought about without considerable ingenuity and skill. There has been no marked extension of sub marine cables during the year, although some sporadic work has been done in duplicating existing sections of cable, and in repairing faults. The loss of the s. s. *Hibernia*, belonging to the Telegraph Construction and Maintenance Company, with a ship-load of cable in Maranham Bay in November, is a casualty still fresh in the memory, and the latest in the train of serious accidents which has attended the laying of the South American east coast cables, a train which includes the loss of the *Gomos* and the *La Plata*.

The adoption of underground in preference to overhead wires by the German Government, is an important indication of the slow revolution which is on foot in favour of the former. It has been settled by law, that in future, all the telegraph lines in the German Empire shall be underground lines. Three main lines have been laid between Berlin and Strasbourg on the one hand, and Berlin and Kiel on the other, while Potsdam has been connected to Cologne. The advantages which subterranean lines have over aërial ones are, a greater immunity from earth currents due to thunderstorms, freedom from sudden changes in insulation resistance, due to changes of the weather, entire removal from such mishaps as the overthrow and breakdown of wires and posts by gales, storms of sleet and snow in winter, or from the violence of mobs. The emancipation of the landscape from its unsightly fetters of rusty wires is by no means a point to be overlooked. The high preliminary cost of the system which has been raised as an objection to its use, will be more than counterbalanced, where the line is properly laid, by the comparatively trifling expenses of maintenance as compared with that for an overhead wire.

The Brown and Allan relay, announced at the beginning of the year, does not appear to have fulfilled the expectations which were formed of its success on long cables, and the Siphon Recorder still retains its impregnable position. We have already mentioned the Edison Pressure Relay; the Theiler Relay for fast speed working, also claims notice for its delicacy and novelty.

The Clamond Thermo-pile, which failed in 1876 to sustain the test of long continued action, and was temporarily rejected, has, we understand, been taken up and improved by Mr. Latimer Clark, C.E., and promises to be more trustworthy and serviceable than it has been heretofore.

The electric light has been conspicuously before us during the past year, and has made some decided advances both in the way of improvement and in its practical application. This activity has been almost exclusively confined to the Continent, where a great number of experimental trials have been made, and works, warehouses, promenades, railway stations, ships, and locomotives lighted by its means. In England it has been applied to Transatlantic steamers, and to ironclads as a means of defence against the attacks of torpedo-boats made under cover of darkness. In June last, the new "electric candle," with the kaolin wick, of the Russian engineer, M. Jablochkoff, was publicly exhibited at the West India Docks, and was considered to be a striking success. In France, the magneto-electric machine of Lontin, by which a number of separate currents of different strengths are generated and distributed to separate circuits in order to feed a separate light in each, has been successfully tried and tested in a long series of experiments made at the Lyons railway-station in Paris, and we believe it has been finally adopted there.

In connection with lighthouse illumination by electricity, the most notable event of the year is the comparative trial of the magneto-electric machines of Siemens, Gramme, and Holmes, made at the South Foreland lighthouse for the Trinity House Board. These trials established the decided superiority of the Siemens' machine over those of Gramme and Holmes which were experimented upon.

In Electrical Science, if no important discovery has been made, the usual amount of minor work has been going on. Dr. Burdon Saunderson and Professor Dewar have carried on investigations on the electromotive power of the tissues of plants and animals. Dr. Saunderson has shown that in plants the leaves and in animals the nerves and muscles are electromotive, while Professor Dewar has shown that light falling on the eye gives rise to an electric current in it. The deposition of metals in films upon glass or other foreign substance by the discharge from an induction coil is also worthy of mention, and is due to Dr. Wright, an American. Count Du Moncel has been as industrious as ever.

In electrical literature the principal works of the year have been Mr. Prescott's "Electricity and the Electric Telegraph;" Mr. Langdon's treatise on the "Application of Electricity to Railway Working;" and M. Hippolite Fontaine's book on "Lighting by Electricity."

The year 1877 is memorable for the deaths of Colonel Robinson, Chief of the Indian Telegraphs, of Alexander Bain, and of Dr. Smee. Bain was distinguished as the inventor of the electro-chemical telegraph, the automatic system, and the electric clock. Smee was well known in telegraphy as the inventor of the Smee battery. The latter was a skilful physician and an accomplished gentleman, the former was an uneducated clockmaker, who, by his extraordinary native genius, seldom, if ever, paralleled in the history of invention, covered himself with a wealth and distinction, which, by temperament and training, he was unfitted to support. Like many other inventors, Bain succumbed to his own success, and died in a state of poverty; but he has left behind him an imperishable name.

The condition of business amongst telegraph contractors during the year cannot be called other than dull. Contractors who do not supply the home government with materials, depend for orders on foreign governments, and it is well known that there is very little activity amongst these at present, owing to the reserved condition of the money market. Contractors are even reduced to tendering for orders at rates under cost price, so as to be able to keep their machines in operation and avoid deterioration of their plant. In default of large foreign orders, attention has been turned to furnishing domestic articles, such as electric bells, telephones, and magneto-electric engines for sewing machines. There is, moreover, little sign of improvement during the ensuing year. There are rumours of schemes in the air, but nothing more. Telegraphic industry is passing through a period of eclipse just now, and must perforce wait in patience, consoling itself with the reflection that like every other eclipse it will in time pass by.

FULLER'S PATENT INSULATOR.

THE form given to insulators for open telegraph lines has almost invariably been that of an umbrella or bell with curved or parallel sides. Most of these particular forms are no doubt due to careful thought, and have been decided upon after numerous experiments. Many of them, however, are such as would lead one to doubt whether any consideration had been given to the obvious rules which must be followed if both mechanical strength and high insulation in all weathers, are to be obtained.

The insulator, recently introduced by Mr. Fuller, seems to possess these two necessary qualifications in a high degree. Its form is that of an inverted truncated cone, by which not only great mechanical strength is provided at that portion of the insulator which has hitherto been found to be weak, and which frequently bursts from the expansion of the iron bolt to which the porcelain is fixed, but with the converging sides of the cone, the insulation is vastly improved by the surface over which the leakage can take place being comparatively small.

The peculiar shape of the improved insulator renders it less liable to the retention of any dust or moisture on its surface than is the case with insulators of the usual forms, while the danger from either external or internal fracture is reduced to a minimum.

The resistance offered to the escape of the electric current over the surface of the porcelain, is still further increased by corrugating, serrating, or undercutting the outside surface of the cone. By this means the downward flow of any moisture which may collect on the surface of the porcelain is broken at several points, and consequently a continuous conducting film can only be formed with great difficulty, if at all.

Another feature in the improved insulator is the method by which the two parts of the insulator, an inner and an outer cup, are fixed together. Instead of employing cement for this purpose, which would rigidly connect the two parts, Mr. Fuller uses a tightly fitting india rubber ring. By the employment of the latter it is possible to separate the two parts for examination, cleaning or renewal, without unbinding the line wire. This is a very great point, and is, we believe, a feature possessed by no other form of insulator. The elastic connection between the two parts must render their liability to break from unequal expansion or from any sudden jar to the wire, very small; also the high insulating property of the rubber must be very beneficial.

Fig. 1.

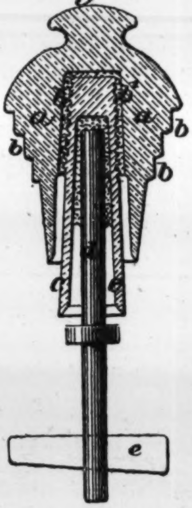
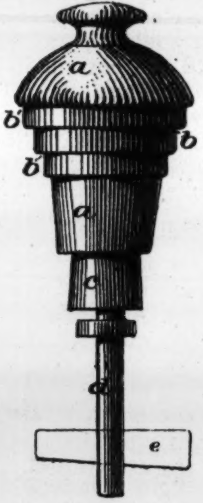


Fig. 2.



In the iron supports or bolts in common use, it is found that the nut and screw required for fastening the insulator to the bracket becomes fixed together so firmly by rust, that great difficulty is experienced in removing the nut when it is necessary to shift the insulator. Mr. Fuller gets over this difficulty by the simple expedient of using a bolt having a slot at the lower end through which a wedge is driven.

Fig. 1 is a vertical section, and fig. 2 a side elevation of the insulator. *a* is the inverted truncated cone portion, and *b b* are the corrugations, serrations, or under-cuttings thereon.

The separate inner cup is also shown in fig. 1, where *c* represents the inner cup and *b'* the vulcanised india rubber ring, *d* is the metal support insulated, as shown, from the inner cup *c*.

If preferred, the inner cup *c* may, of course, be cemented to the inverted cone *a*, though the advantage of the elastic connection would be lost thereby.

e e, figs. 1 and 2, show the wedge or cutter passing through a slot in the metal support *d*.

A SKETCH OF THE DEVELOPMENT OF THE ELECTRIC LIGHT.

By J. MUNRO, C.E.

(*Continued from page* 309.)

The next important advance was made in 1866, when Mr. H. Wilde, of Manchester, announced the somewhat paradoxical principle that a current or a magnet indefinitely weak could be made to induce a current or a magnet of indefinitely great strength. Wilde showed, in fact, that by means of a slight trace of magnetism a feeble current could be generated in the armature, and that that current could be used to excite an electro-magnet, which would in turn re-act on the armature, so as to generate a more powerful current in the latter. By employing this current to excite the electro-magnet still more, a still stronger current could be induced in the armature, and so on until the current in the armature was of the required strength. The weak initial magnetism required could be obtained from a permanent magnetism, or the residual magnetism of the core of the electro-magnet, caused by the temporary flow of a voltaic current through the coils of the electro-magnet. On this principle, Wilde constructed a very powerful machine, which, under improved forms, is now in use. He provided two armatures—one for intensity, and one for quantity—and wound them longitudinally, after the manner of Siemens. The quantity armature was wound with folds of insulated copper-plate or ribands instead of wire. With an armature of this kind, ten inches in diameter, Mr. Wilde melted an iron rod fifteen inches long and a quarter of an inch thick. With an intensity armature of the same diameter, he produced a light from half-inch carbon electrodes, which, at a distance of a quarter of a mile, cast shadows from the flames of the ordinary street lamps against the neighbouring walls. The same light at two feet distant from the reflector darkened ordinary sensitised photograph paper to as deep a hue in twenty seconds as the direct rays of the sun at noon of a clear March day did in a minute.

Various useful dynamo-electric machines, as they have been called, were planned on Wilde's principle by electricians both at home and abroad. S. A. Varley, Siemens, and Wheatstone showed that the residual magnetism of the core of the electro-magnetism was sufficient to originate a current which, by the above process, could be made to generate powerful currents in the armature; and that this current could be utilised for the electric light by *shunting* off a part of it through a circuit derived from the electro-magnet circuit, and in which the electrodes of the light were placed. The strength of the current, which can be generated by this reciprocal magneto-electric action, is limited by the magnetic capacity of the core of the electro-magnet, and also in some measure by the heat generated in the rotation of the armature. In 1867, Mr. Ladd, London, exhibited at the Paris Exhibition a machine with two armatures, of which one was employed to *feed* the exciting electro-magnet with current, and the other to produce the useful or light-giving current. Mr. Tisley improved Ladd's machine by adding a novel commutator, and also cooling the bearings of the armature by passing a stream of cold water over them.

The next great advance was made by Zenobe Theophile Gramme, of Paris, who patented his machine in England in 1870. Gramme's machine involved the new principle of forming the moveable armature of an endless ring of soft iron, round which are coiled a series of separate helices or bobbins connected in circuit one after the other. Each of these coils *ride*, as it were, on the soft iron ring, and is carried round with it across the lines of force between the poles of the magnet, which may be either a powerful permanent magnet built up of thin laminæ, or electro-magnets excited by the armature itself in the way we have been considering. The induced magnetic poles in the ring are continuously shifting round the ring as it revolves, and the effect on the bobbins is the same as if two opposite poles, diametrically apart, revolved continuously round them. In one revolution, while the bobbins on one half of the ring are passing a north magnetic pole, those on the other half are passing a south pole. One half of the bobbins will therefore yield induced currents in one direction, while the other half yield them in the other direction. Each bobbin is like the element of a Leyden battery, and yields its momentary current; but the rapid succession of the series of bobbins produces a practically uniform current. The ends of each bobbin are swept by a pair of metal brushes, which collect the magneto-electric currents generated in them. Each brush collects the opposite currents in order to convey it away for use, and thus the brushes resemble the poles of a voltaic battery. Gramme's machine possesses extraordinary power.

In Siemens improved machine, patented 1873, Gramme's plan of having a number of separate coils in series on the armature, with metal brush-contacts for leading off the currents, is applied to Siemens' armature, that is to say, instead of having a single coil wound longitudinally on the armature and a commutator to divert the alternating currents, a number of longitudinal coils are now connected up in series and rubbing contacts substituted for the commutator. Siemens, however, further improves his machine by detaching the soft iron core from the armature and keeping it fixed, the coils of the armature alone being moveable. These coils are wound on a light shell which revolves rapidly in the highly magnetic space between the poles of the magnets and the fixed core of the armature. The distinction here between Siemens' and Gramme's machines lies in the fact that whereas Gramme rotates his soft iron armature core along with its coils, Siemen keeps it fixed and rotates the coils round it.

At least two other new forms of magneto-electric machines are worthy of mention. Wilde's form, patented in 1873, and Lontin's, patented in 1876. The novel feature of Wilde's machine consists in causing the rotation of an iron armature to generate the induction currents, not in coils round the armature itself, but round the prolonged ends of the magnets which produce the magnetic field. M. Francois Lontin's plan is simply another means to the same end; the inducing electro-magnets are prolonged and encircled by extra coils in which the rotation of the armature generate currents which can be employed for the electric light. An obvious advantage of this plan of Wilde and Lontin, is that a number of distinct currents can be generated by the motion of the armature, each in its own particular electro-magnet, which can be utilised for different lights.

There are several other very useful magneto-electric machines, such as the Alliance or Nollet machine, Noble's, Ladd's, Breguet's, Holmes', &c., but they do not involve original improvements of sufficient importance to deserve an extended description here. Gramme's machines have been described in greater detail already in the *Telegraphic Journal*, vol. 3, p. 184. vol. 5, p. 190; and Siemens' also in the *Telegraphic Journal*, vol. 1, p. 320, and vol. 5, p. 272. The recent comparisons of these two machines at South Foreland by the Trinity House, show results in favour of Siemens'. This instructive report is to be found in the *Telegraphic Journal* for Nov. 1, 1877.

While invention was, step-by-step, perfecting the magneto-electric machine, regard was also had to the bettering of the carbon points or luminous electrodes of the light. The wasting of the carbon points necessitated a contrivance for regulating the distance between the points, so as to keep the arc of sensibly constant width. The electric arc has a considerable resistance in ohms, and its resistance increases or diminishes according as the width is greater or less. With the rise or fall of resistance in the arc, the current diminishes or increases. It occurred, therefore, to Foucault, the first inventor of the regulator for the carbon points, to cause the current by means of an electro-magnet to move the points to or from one another, according as the arc became too wide or too narrow. When the points are at their proper distance, the current, by means of the electro-magnet through which it passes, is made to hold a detent which keeps the points steady. But when the arc widens, and the current gets weaker, the detent is released, and the points are permitted to approach. Foucault's regulator was improved by Serrin and by Dubosq. Serrin's form had two independent trains of clockwork, one designed to allow the points to approach, the other to draw them apart. These trains were actuated by the current passing through an electro-magnet. Dubosq's form is the best known, and is merely an improvement on Serrin's. The current passes through an electro-magnet and thereby opposes a coiled spring. The spring tends to bring the points closer, the electro-magnet tends to push them apart. Their actual position, therefore, depends on the strength of the current. If it is weak, the spring overpowers the magnet and brings the points nearer. If it is strong, the magnet overpowers the spring and pulls the points wider apart. M. Lontin effects the same purpose by the dilatation of a fine silver wire which actuates a system of levers.

The nature of the points was also a matter for research and invention. The value of carbon as electrodes is the whiteness and abundance of the light it yields, and the fact that it does not fuse at the high temperature of the arc. But there is a want of uniformity in the structure of carbon; it is porous, absorbent, and is given to spark and explode in burning. These qualities, together with its rapid disintegration and combustion, are objections to its fitness for electrodes. Other substances, such as spongy platinum, iridium, palladium, were suggested and tried. A very fine green light was obtained from a stream of mercury falling upon a platinum or carbon plate. The mercury was one electrode, the plate the other, and the light appeared where the mercury broke in globules on the plate. Professor Wray proposed to employ this plan for lighthouse illumination. Carbon steeped in various chemicals was tried. When it is soaked in nitrate of strontium or chloride of zinc the arc is very equable and constant, but the light is coloured. The colouring of the light due to these different metals was also against their adoption. Loose carbon between metal electrodes in a sealed glass tube yielded a good light, and had the advantage of requiring no regulator. It is an idea as old as 1841, and almost anticipates one of the most successful of recent lights. In 1856, Mr. Harrison proposed to set the points at right angles to each other, and to give the positive point a motion of rotation round its own axis, and the other a motion of translation, so as to secure that the fresh carbon surface should come under the negative point. This useful idea was revived by Mr. Whitehouse a few years ago. The quality of the carbon itself was greatly improved. With wood charcoal the light is more vivid and whiter than with coke. There are several French makers of carbon points. M. Archereau prepares them of finely-divided carbon and magnesia, pressed; M. Carré, of fine coke-dust, lamp-black, liquid gum, and sugar, baked; M. Gaudoin, of tar, resin, or mineral oil carbon, pressed, and wood charcoal. Those of M. Gaudoin are said to be the best. Enclosing the carbon in glass prevents the air from deranging the arc.

With the perfecting of magneto-electric machines and the refinement of the points, the carbon light became successful as an illuminator where powerful lights were required, as for flashing signals, theatrical effects, and beacons on land and at sea. In 1862, England took the lead in applying it to lighthouse purposes at Dungeness. The following year France established the light on Cape La Heve, and, among others, the Cape Grinez light was set up in 1869, and the South Foreland in 1872; these two latter making, with Dungeness, a triangle of lights over the Channel.

These powerful and somewhat expensive lights, however, are unfit for the general illumination of streets and buildings. With such small individual lights as are there required, the carbon points are unreliable and the lights unequable. The necessity of regularly supplying fresh points is also an objection; but the main difficulty lies in the proper division of the light among various jets of different sizes. It is clear that by connecting a number of different sets of points in series, the break-down of one set would interrupt the current and extinguish the whole. Again, the use of a variety of circuits derived from each other, and dividing up the main current from the machine into a number of branch currents, is attended with several practical difficulties; for example, the extinguishing of one light would increase the brightness of the rest, since the current which had been supplying it would help to strengthen the currents in the other branches.

(*To be continued.*)

EDISON'S TALKING PHONOGRAPH.

THE principle on which the machine operates is as follows:—There is, first, a mouth piece, A, Fig. 1, across the inner orifice of which is a metal diaphragm, and to the centre of this diaphragm is attached a point, also of metal. B is a brass cylinder supported on a shaft, which is screw-threaded and turns in a nut for a bearing, so that when the cylinder is caused to revolve by the crank, C, it also has a horizontal travel in front of the mouthpiece, A. It will be clear that the point on the metal diaphragm must, therefore, describe a spiral trace over the surface of the cylinder. On the latter is cut a spiral groove of like pitch to that on the shaft, and around the cylinder is attached a strip of tinfoil. When sounds are uttered in the mouthpiece, A, the diaphragm is caused to vibrate and the point thereon is caused to make contacts with the tinfoil at the portion where the latter crosses the spiral groove. Hence, the foil, not being there backed by the solid metal of the cylinder, becomes indented, and these indentations are necessarily an exact record of the sounds which produced them.

FIG. 1.

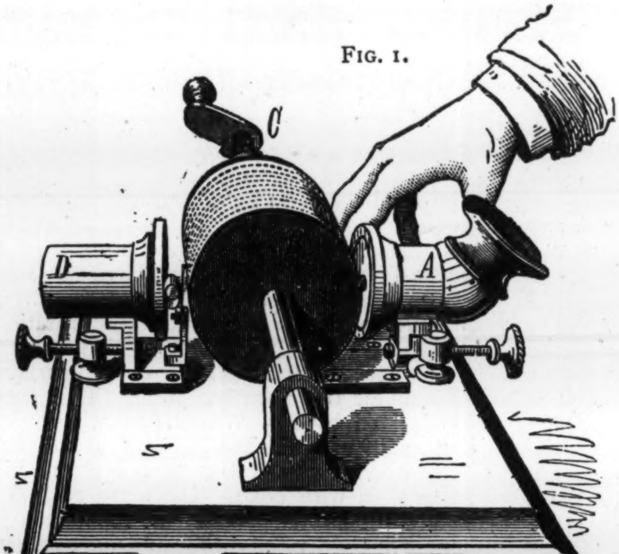
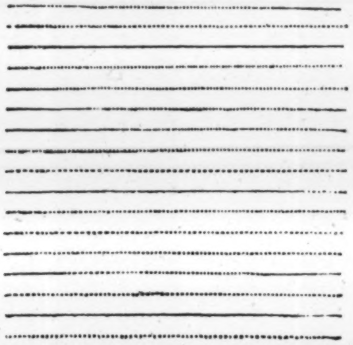


Fig. 2.



It might be said that at this point the machine has already become a complete phonograph or sound writer, but it yet remains to translate the remarks made. It should be remembered that the Marey and Rosapelly, the Scott, or the Barlow apparatus proceed no further than this. Each has its own system of caligraphy, and after it has inscribed its peculiar sinuous lines it is still necessary to decipher them. Perhaps the best device of this kind ever contrived was the preparation of the human ear made by Dr. Clarence J. Blake, of Boston, for Professor Bell, the inventor of the telephone. This was simply the ear from an actual subject, suitably mounted and having attached to its drum a straw, which made traces on a blackened rotating cylinder. The difference in the traces of the sounds uttered in the ear was very clearly shown. Now there is no doubt that by practice, and the aid of a magnifier, it would be possible to read phonetically Mr. Edison's record of dots and dashes, but he saves us that trouble by literally making it read itself. The distinction is the same as if, instead of perusing a book ourselves, we drop it into a machine, set the latter in motion, and behold! the voice of the author is heard repeating his own composition.

The reading mechanism is nothing but another diaphragm held in the tube, D, on the opposite side of the machine, and a point of metal which is held against the tin-foil on the cylinder by a delicate spring. It makes no difference as to the vibrations produced, whether a nail moves over a file or a file moves over a nail; and in the present instance it is the file or indented foil strip which moves, and the metal point is caused to vibrate as it is affected by the passage of the indentations. The vibrations, however, of this point must be precisely the same as those of the other point which made the indentations; and these vibrations, transmitted to a second membrane, must cause the latter to vibrate similar to the first membrane, and the result is a synthesis of the sounds which, in the beginning, we saw, as it were, analysed.

In order to exhibit to the reader the writing of the machine which is thus automatically read, we have had a cast of a portion of the indented foil made, and from this the dots and lines in Fig. 2 are printed in of course absolute facsimile, excepting that they are level instead of being raised above or sunk beneath the surface. This is a part of the sentences, "How do you do?" and "How do you like the phonograph?" It is a little curious that the machine pronounces its own name with especial clearness. The crank handle shown in our perspective illustration of the device does not rightly belong to it, and was attached by Mr. Edison in order to facilitate its exhibition to us.

In order that the machine may be able exactly to reproduce given sounds, it is necessary—first, that these sounds should be analysed into vibrations, and these registered accurately in the manner described; and second, that their reproduction should be accomplished in the same period of time in which they were made; for, evidently, this element of time is an important factor in the quality and nature of the tones. A sound which is composed of a certain number of vibrations per second is an octave above a sound which registers only half that number of vibrations in the same period. Consequently, if the cylinder be rotated at a given speed while registering certain tones, it is necessary that it should be turned at precisely that same speed while reproducing them, else the tones will be expressed in entirely different notes of the scale, higher or lower than the normal note, as the cylinder is turned faster or slower. To attain this result there must be a way of driving the cylinder, while delivering the sound or speaking, at exactly the same rate as it ran while the sounds were being recorded, and this is perhaps best done by well-regulated clockwork. It should be understood that the machine illustrated is but an experimental form, and combines in itself two separate devices—the phonograph or recording apparatus which produces the indented slip, and the receiving or talking contrivance which reads it. Thus in use the first machine would produce a slip, and this would for example be sent by mail elsewhere, together in all cases with information of the velocity of rotation of the cylinder. The recipient would then set the cylinder of his reading apparatus to rotate at precisely the same speed, and in this way he would hear the tones as they were uttered. Differences in velocity of rotation within moderate limits would by no means render the machine's talking indistinguishable, but it would have the curious effect of possibly converting the high voice of a child into the deep bass of a man, or *vice versâ*.—*Scientific American.*

ERRATUM.—Review of "The Application of Electricity to Railway Working," page 311, 2nd column, line 27, *for* "does not really give any," *read* "really gives that."

THE TELEPHONE AND ITS APPLICATION TO MILITARY* AND NAVAL PURPOSES.

By **W. H. PREECE**, Vice-President Soc. T. E. and Member Institution Civil Engineers.

No one can deny the enormous value of the electric telegraph for warlike purposes. It has well nigh revolutionised the art of war. It has become a great weapon of offence, as well as a great shield of defence. Operations that were a few years ago impossible are now regarded as essential. The strategist in his office can now grasp a continent in his combinations. The actual manœuvres of armies can be controlled and directed like the toy figures of the game of Kriegs-spiel. The maintenance of the lines of telegraph to an army in the field is as important as that of the more material lines of communication. The telegraph, in fact, has become a necessity of the age. No war could now be undertaken without its aid.

But it is not only in annihilating space, and bringing within the mental view of the master mind a dozen armies and a million men, that telegraphy is so valuable; it is in the rapid communication of intelligence and orders to and from the commanding officers of each limb of each army, however small; it is in connecting together, in immediate communication, the different parts of a fortress or an entrenched camp, however much they may be scattered; it is in maintaining an uninterrupted connection between all parts of a besieging force, however extensive may be the lines of circumvallation, that it is so serviceable. It would have been impossible to have kept on the sieges of Paris and Metz without it. Indeed, it has a civilising influence, for it not only tends to shorten the duration of war, but to diminish the loss of life, by rendering possible those combinations which, in the cases of Sedan as well as of Metz, swallowed up temporarily in prison two great armies. Moreover, it facilitates the supply of food, it regulates the traffic on railways, and it aids the transport home of the sick and wounded; it satisfies the craving for news, and it alleviates anxiety. It is well known that the Germans, guided by their experience of 1866, commenced the war of 1870 with a very well organised and extensive system of telegraphs for field service, but that the French had a system wanting in efficient organisation and miserably deficient in men and material. We know little of the present Russian system, excepting the fact that by its aid the army around Plevna maintained its bear-like hug on the doomed fortress, and enabled it to thwart, with overpowering force, the tiger-like rush of Osman Pasha.

So important is efficient telegraphy now considered for the British Army, that 6 officers and 160 men are being trained and maintained in efficiency in the British postal telegraph system, so as to be available in time of war. They are, in fact, daily rehearsing that part which they may have some day to perform in earnest in an enemy's country. Moreover, we have our field telegraphs in constant training at Aldershot, Chatham, and elsewhere, though it is very doubtful whether this department has been nearly sufficiently developed, or is anything like being properly equipped, for such an army as ours. However, I am here, not to criticise or describe the equipment of our military telegraphic system, but to describe an apparatus which may prove a most useful and valuable adjunct to the already well-matured system of waggons and barrows and cables in actual use. I must draw a distinction between the permanent telegraphic system of the country occupied by an army, the semi-permanent lines of telegraphy which connect headquarters, as it advances, with this system, and the "flying line," or temporary system of field telegraphs which follows the movements of the various corps in the field, and maintains their communication with headquarters. The first two must necessarily be worked on the ordinary telegraphic system in use, maintained by technical skilled labour, and worked by well-trained, experienced telegraphists. The flying line need not necessarily be so manipulated. There is also the visual system, intended for outpost and reconnoitring duties, and which necessarily must be continued under circumstances which render field telegraphs impractical. I do not intend to refer to this admirable system.

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* Read before the Royal United Service Institution, Dec. 21st.

At present, the apparatus in use for field telegraphy is the ordinary Morse recording apparatus, which records its messages in the ordinary dot and dash alphabet, understood only by the initiated, supplemented by a sounding instrument, which appeals, by a similar foreign language, to the ear. Thus, to convey intelligence from one point to another, a message has to be written down on paper. It has then to be translated by a telegrapher into the Morse language, which has to be re-translated at the distant end into the ordinary written language, and then read by the recipient. These operations are subject to error, and have not secured faith in their reliability. Is there any commanding officer here present who would not wish such an uncertain agent in a very warm place? Those who were present at the Autumn Manœuvres on Salisbury Plain know how to value its services. It is unquestionable that the telegraph has not inspired confidence, and this is due as much to its natural uncertainty as to the want of knowledge of the tool that is used. Accuracy in the transmission of orders is the *sine quâ non* of a military telegraph. We know of one great disaster that arose from a mistake. "Some one has blundered." It was the very last thing determined upon in our late Ashantee War, and the rapidly collected materials drawn from the Post Office stores were dispatched at the last moment by passenger train, and stowed in the officers' baggage room. Yet we have the authority of Sir Linton Simmons for saying that the operations in that war could not have been carried on as they were without its assistance, and that it was productive of very great economy to this country by shortening the expedition, and enabling the greatest amount of benefit to be derived from the materials and means that were placed at the disposal of the general in command.

Now, the telephone, if it prove a practical instrument, will place in the hand of every officer an instrument which will transfer the actual words and tones of his own voice to his correspondent at any reasonable distance. I have spoken distinctly at various distances up to ninety miles, and I have been able to recognise, with absolute certainty, the voices of different people at sixty-seven miles. It will solve the moot question as to the best form of instrument for military telegraphs, about which there is much diversity of opinion.

How is it that the human voice itself can be reproduced at such distances? When I strike a bell, blow a whistle, sound a reed, clap my hands, or speak to you, how is it that these different operations are conveyed through your ears so as to produce on the brain that sensation which is called *sound?* The air itself, in which we breathe and move and have our being, is a highly elastic medium, which readily receives and transmits any motion imparted to it. When I clap my hands I suddenly throw this air into motion; a wave is formed, just like a stone thrown into water generates a wave that circles round and round, striking and enveloping everything in its course. This air-wave likewise envelops everything in its course, and impinging upon the tympana of your ears, it there affects the nerves in such a way as to convey to the brain that sensation which education has taught us to be that sound due to the clapping of hands. Sound is therefore simply the undulations of the air; but there is sound and sound. I shake this box of nails; it makes a hideous row. I blow this reed; it makes a soft musical tone. Why have we in the one case *noise* and in the other *music?* In the one case the waves follow each other in irregular, spasmodic fashion, shivering the drum of the ear with unpleasant shocks; in the other case the waves follow each other regularly, periodically, and rythmically, blending together on the drum of the ear with pleasant sensations. Let us ignore noise, and confine ourselves to this musical instrument. I blow a note. If it were possible to illuminate a tube of air between the mouth of this instrument and any one of your ears, you would see this air chased and moulded into the most beautiful and regular undulations; not rises and falls, like the vertical waves of the sea, but condensations and rarefactions—close order and open order—more like a field of barley in autumn time responding to the motion of a gentle breeze. If we conceive a line of particles to be arranged along this tube, like a long file of men or a row of marbles, then if each particle takes an excursion to and fro for the same distance (the same *amplitude*), however small, then if the motion of each particle be successive, and not simultaneous, the line will be excited into waves or sonorous vibrations.

Now let us fix our attention upon this musical instrument and this suppositious tube of air. I can produce various *notes.* One note differs from another note only in the number of waves or sonorous vibrations produced per second. Middle C of the piano makes 264 of these vibrations, E 330, F 352, A 440, and the octave to C 528 per second. The lowest note that can be heard by the human ear is 16 complete vibrations per second; the highest, 38,000. The range of the human voice is between 65 and 1044 sonorous vibrations per second. Whenever and however we produce air vibrations pursuing each other regularly between these two limits, we have *notes.* And one note differs from another note in its *pitch,* which is the number of its sonorous vibrations per second. But these notes may be soft and gentle, or rough and loud. Hence notes differ, not only in their *pitch*, but they differ in their *loudness*. Loudness depends upon the energy of the source of sound, and upon the amplitude of the consequent vibrations of the particles of air. If I blow gently, the excursion to and fro is small. If I blow fiercely, the excursion to and fro is great. The former undulations strike the ear gently, and the sensation is low; the latter strike it fiercely, and the sensation is loud. Again, I take three or four different instruments, and I sound the same note on each with the same force. The pitch is the same, the loudness is the same, but there is no mistaking their difference. This difference is called their quality, clang-tint, or *timbre*. Now what causes this clang-tint? I must beg your attention here, for here lies the secret of the new articulating telephone. This clang-tint is due to the *form* of the wave of air. It is very difficult to conceive a difference in the form of a wave of air. It is simple enough when we regard water. We see this for ourselves upon the surface of a pond or of the mighty deep. But the difference of an air-wave lies, not in its geometrical form so much as in the rate of motion of its different particles. I wave my hand backwards and forwards regularly or irregularly. I can make it move at any given rate, at any given time, and, though the number of excursions and the amplitude of excursion to and fro per unit of time may be the same, I can vary the form or rate of excursion at will. This produces difference of quality, and this is why middle C, sounded on the piano, on a harp, on a bugle, or by the voice is the same note, but differing so much in clang-tint. It is impossible to picture in the mind the beauty and minuteness of the sound-waves. The ear, though approached by a channel the diameter of only a quill, will receive the vibrations from a hundred voices and instruments, and can separate each by attention. Hence we arrive at our first proposition, that sound is due to the undulations of the air, and that, as these undulations vary in number per second, in amplitude, and in form, so we have noise or music varying in pitch, in loudness, and in clang-tint.

(To be continued.)

THE "TIMES" AND TELEGRAPHY.

ENGLISH electricians will read with satisfaction the following article in *The Times* of Christmas Day:—

"The first article in the December number of the Berlin 'Archiv für Post und Telegraphie' is entitled 'Germany's Share in the Development of the Telegraph.' It urges that the article on 'Telegraphic Progress' which appeared in *The Times* of November 22, is written in too insular a spirit, and that while the claims of certain Englishmen and Americans are set forth, the work of the scientific men of other nations has not been duly recognised. The progress of the telegraph has been an international work even from its earliest stages, and to claim as *The Times* article has claimed that all the discoveries up to 1843 were due to English genius is not a fair representation of facts. It recognises that Le Sage's name is just mentioned, but indicates that his work is too lightly passed over and draws attention to the fact that many important names associated with work on which telegraphic progress is founded are altogether omitted. There are, it says, not a few Germans who have made themselves worthy to be prominently mentioned, as there are also philosophers of other nations. For example, without the discovery of galvanism the present science of telegraphy would have been an impossibility, and with this discovery the names of the Italian philosophers, Galvani and Volta, are closely bound up, while the discovery of the principle of the galvanometer is due to Œrsted, a Dane, almost simultaneously with Schweiger and Poggendorf. The invention of the galvanometer was the first step towards the needle telegraph, and the honour of first seeing the application of this is due to the French *savant* Ampère. The laws of the strength of currents, without which apparatus could not be rationally constructed, were first worked at in 1825 by the distinguished German Ohm, which led to the discoveries in 1845 by Kirchoff. Then came the 'epoch making' labours of the Göttingen Professors Gauss and Weber. These facts the German writer considers are sufficient to show that it is an 'arrogant assumption' on the part of the English writer to claim the earliest stages of the invention and development of the telegraph as purely English. When the British Association appointed a committee to report on suitable units as the standard of electrical resistance there were four names suggested for them—an Ohmad, a Volt, a Weber, and a Faraday—so that here there were recognised one Englishman, one Italian, and two Germans. The article goes on to point out that the constant battery is due to Becquerel and Daniell, and the discovery of the earth circuit and the application to the telegraph is due to Steinheil. The first idea for the employment of galvanic currents for telegraphic signals originated with Sœmmering. He showed how the chymical decomposing property of the currents could be made to indicate letters (as Le Sage had with frictional electricity), and exhibited his 'water decomposition telegraph' at an Academy meeting in 1809. He may be regarded as the real founder of our present telegraphic knowledge, as he was the first to recognise the possibility of employing galvanic electricity to convey signals to a distance. The needle telegraph came as the next step—the deduction from the galvanometer; and here the Prussian Schilling, with his submarine wire, must be named, as well as Gauss and Weber (1833). Fothergill Cook, who is named in *The Times* article in connexion with Wheatstone as inventor of the needle telegraph, was in 1835 at Heidelburg studying wax modelling for the museum of the University of Durham, when he accidentally saw an instrument that belonged to Muncke, with which it was possible to telegraph from one room to another. He took up the idea and worked it out with Wheatstone, but he cannot claim the invention. Siemens, Von Chauvin, Halske, and Edlund are mentioned in connexion with the development of duplex and quadruplex telegraphy, but the writer has omitted to mention the name of Edison, which, perhaps, should take the place of the names of Prescott and Gerritt Smith. The comments of the German writer, prejudiced as they are, usefully draw attention to the fact that a good international history of the telegraph has still to be written."

The "arrogant assumption" there alluded to is confined solely to the writer of the article "On Telegraphic Progress." The art of telegraphy, like science in general, is purely international, and English telegraphists accept and acknowledge unreservedly all contributions from abroad. No standard work can be pointed out which does not fully acknowledge all that the German writer contends for, and it is unfair to saddle upon the profession at large that "insular spirit" which is confined to an ignorant writer in *The Times*.

THE KAFFIR WAR AND THE TELEGRAPH.

WE are very glad to find that owing to the able and astute management of Mr. Sivewright, of the Telegraph Department of Cape Colony, the services rendered by it during the late Galeka affair has been such as to elicit a warm acknowledgment of them by the Commissioner of Crown Lands and Public Works, Mr. John Merriman.

We give the text of Mr. Merriman's letter with much pleasure, as it shows how great is the value of a telegraph system properly managed at such moments as that referred to. We trust that the Cape Government will be as ready to acknowledge these services as is their Commissioner, and we congratulate Mr. Sivewright on the energy displayed by him.

"King William's Town,
"12th Nov., 1877.

"MY DEAR SIR,—I cannot allow you to leave King William's Town without expressing to you the high sense which I entertain of the services rendered by you to the colony during the past trying six weeks. I have no hesitation in saying that to your personal presence in King William's Town has been owing in a great measure the admirable service which the telegraph has been able to perform during the war. Nothing can have exceeded the cheerfulness and skill with which, at a time when frequent interruptions would have been beyond calculation detrimental, you devoted yourself with marked success to the duties of your department with a zeal and tact beyond all praise, and for which I have personally to anticipate the thanks which at a more fitting time the Government will communicate to you.

"I am, my dear Sir,
"Yours truly,
"JOHN X. MERRIMAN,
"Commissioner of Crown Lands
and Public Works."

"J. SIVEWRIGHT, Esq.,
Aliwal North."

THE DESTRUCTION OF SUBMARINE CABLES.

SUBMARINE CABLES are subject to numerous causes of deterioration. In the first place, on Northern shores, there are the banks of floating icebergs, which sometimes extend to a depth of 500 or 600 metres. In their journey southwards, these ground and break up under water; the broken masses dislodge the cable which crosses their path. This kind of accident often occurs to the Atlantic Cables on the coasts of Newfoundland.

Next to ice-banks must be mentioned wear and tear on rocky bottoms. Near the coast-line, says M. Ternant, in a treatise on the repairing of submarine cables, the depth may vary rapidly, so that the cable does not lie evenly on its bed; one end lying on a rock may have to bear the entire weight of the portion of cable which is unsupported. A continuous to-and-fro movement, arising from the agitation of the sea or from ordinary tides or currents, determines the gradual wearing away, albeit slow, of the external wires. The sheathing once destroyed, the conducting wires yield and break, or the continued attrition of the core lays bare the conductor, making earth and stopping communication. The cable between Bonifacio and Sardinia was interrupted in 1861 from this cause; and the six conductors it contained were broken by the stretching inside the gutta-percha, which only yielded to the strain in picking up. We may further mention as causes of destruction, coral-beds, earthquakes, submarine eruptions, and high temperature on tropical coasts.

The enemies in the animal kingdom are not less numerous. A curious observation was made after the laying of the cables on the Brazilian coast. As is known, Brazil was connected with Portugal in 1875. At the same time a series of cables round the coast completed the system from Pernambuco to Para, Cayenne, Demerara, and the Antilles. The observation referred to was made in the Para-Cayenne section. It consisted of singular bites due to attacks made by the saw-fish, which abounds in those parts. A similar occurrence to the Singapore Cable in 1871 was described in *La Nature* in 1873 (Vol. I., p. 160). Mr. Buckland found among his collection a fish-jaw, from which he detached the saw; and with this he reproduced upon a piece of cable a fault similar to that which had caused the interruption.

In Brazil, this kind of fault has become chronic; we gather our information from the engineers in charge of the laying. In the first piece which failed, one of the protecting iron wires was wrenched so as to expose the hemp with which the core was served. In the centre of this part a piece of bone, apparently the scale of a fish-tooth, was found thrust through the hemp into the gutta-percha. On the same side of the cable, about two inches distant, another piece of bone was found in a similar position. Each of these scales was about one inch in length, and about one-eighth of an inch in diameter.

In another fault, one of the wires was bent inwards, the remainder of the strand being slightly deformed and the "lay" taken out. One of the crew, during the heaving in, drew out from the cable a triangular splinter of enamelled tooth, about a quarter of an inch thick; this piece was fixed between the wires. On stripping the core, a small puncture was discovered, as if made with a broach.

A third fault was of a more mysterious nature. The cable showed no appearance of being defective. When the external coverings were stripped off, and the core bared, a hole about the size of a pin's head was seen, filled with a whitish substance resembling glazier's putty. One wire of the internal sheathing was found severed exactly over this hole; the external iron wire which lay immediately over was bent into a crook about two inches off. A small portion of the exterior serving was displaced in the region of the fault. On cutting through the core close to the fault, so as to expose the conductor, more of this soft, crushed, pasty matter was found. Two small fragments of hard bony substance were found in the interior serving. These bites showed traces of decomposition; but they were so small that it was difficult to say if the foreign matter was bone or scale. The fragments were somewhat fibrous and semi-transparent: there is little doubt, having regard to other signs, that they came from a fish. The white substance was certainly decomposed dental matter.

These three faults were all found within 15 miles of each other, about 130 miles from Para. A fourth one was found in the deep-sea type; and although no fragments of teeth were discovered in it, the distortion of the sheathing wires showed that it was due to the same cause as the preceding. A fifth fault, picked up 270 miles from Para, half way to Cayenne, was not so evidently caused by fish, although such is just possible. The core in this case was pierced as before, but this time the hole was filled with a black substance; the copper gave signs of indentations like teeth marks. The teeth must have been very strong to have freed themselves. Mr. Warren has told how that after these faults had been taken out, the cable was again interrupted in the following year with five more fish bites at about the same place. From one of these a piece of hard bony substance, an inch and a half long, was taken, while the piece still fixed in the cable was an inch in circumference. Mr. Warren was much puzzled to know by what fish these attacks were made, until arriving at Demerara, where he identified the teeth of the saw-fish, which abounds in those waters, and on all the northern coast of Brazil.

After the saw-fish, three insects may be mentioned whose misdeeds have been known some years, and which were described by Mr. Preece before the Society of Telegraph Engineers.

The *Teredo navalis*, and its congener, the *Xylophaga*, which Huxley discovered for the first time in 1860, in one of the Levant cables, lodge themselves in the hemp, penetrating even to the gutta-percha wherever an opening in the sheathing allows them a passage.

The *Teredo* is a worm which constructs a shelter in the form of a tube by secreting calcareous matter. The *Xylophaga* is a bivalve. The latter does not penetrate far into the gutta-percha; it only fixes one valve into it. In small cores this is sufficient to produce a considerable loss of current.

The *Teredo* and the *Xylophaga* are found in the Mediterranean, in the Atlantic, and even in the northern seas.

The *Teredo norvegica* is a worm of considerable dimensions, and is armed with bivalves in the form of shells, which enable it to gnaw the hardest wood. It belongs to the class of acephalous molluscs; naturalists count at least twenty-four different species.

The *Limnoria lignorum*, called also *L. terebrans* by Dr. Carpenter, is a little crustacean of the size of an ant, so that it can get through the interstices of the sheathing wires even of the best-made cable, and penetrate to the core, through which it burrows. In the Indian Ocean and the Persian Gulf, the *Limnoria* attains larger proportions, and effects excavations of considerable size. It is frequently met with on the shores of Ireland, where several cables have been seriously damaged by it.

To exhaust the subject, we will quote the part, which, according to M. Ternant, is played by the whale in accidents to submarine cables. During the laying of the first Atlantic Cable, in 1859, a whale very nearly broke the cable in crossing the stern of the *Niagara*. Another, and still stranger, adventure, is told of one of the Persian Gulf Cables, from Gwadur to Kurrachee. The accident, says M. Ternant, was of such an extraordinary nature that it is necessary to quote the official source of information.

Mr. Isaac Walton, superintendent of telegraphs for Mekran and the Persian Gulf, reports as follows to the Government at Bombay: "The cable from Kurrachee to Gwadur, about 300 miles long, was suddenly interrupted on the evening of the 4th inst. The telegraph steamer, *Amberwitch*, Captain Bishop, with the staff of engineers and electricians, under the orders of Mr. Hy. C. Mance, started next day to repair the fault, which was estimated to be 116 miles from Kurrachee, according to the tests taken from both ends.

"The *Amberwitch* arrived at this place at two o'clock on the afternoon of the 6th. The sea was rough, and there was a thick fog at the time, but the cable was nevertheless hooked at a quarter of a mile from the point of rupture.

"The soundings taken about the place of this break were very irregular, and showed a jump from 70 to 30 fathoms. In hauling in the cable an unusual strain was experienced, as if the cable had fouled a rock, but on persevering for some time, the body of an enormous whale, entangled in the cable, was brought to the surface; it was found to be firmly held by two and a half turns of the cable, taken immediately above the tail. Sharks and other fish had partly devoured the carcass, which was rapidly decomposing, the jaws coming adrift on arriving at the surface. The tail, which was 12 feet wide, was perfectly preserved, and was covered with numerous shells at its extremities. Apparently the whale had rubbed itself against the cable for the purpose of ridding itself of parasites, and had with a stroke of the tail, broken the cable, and, at the same time, so coiled itself up in it as to be strangled thereby."

We conclude, with M. Ternant, that this accident shows how important it is by a complete survey of the sea-bottom to avoid sudden inequalities of soundings near coasts. — Ch. BONTEMPS in *La Nature*.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

[THE Report of the Proceedings of this Society is unavoidably postponed until our next issue, owing to the MS. having miscarried in its transit through the post.—EDIT. TEL. JOUR.]

PHYSICAL SOCIETY.—15TH DECEMBER, 1877.

Prof. G. C. FOSTER, President, in the Chair.

THE following candidates were elected members of the Society:—W. E. Ayrton, J. M. Cameron, J. W. Clark, J. E. Judson, B.A., H. N. Moseley, M.A., F.R.S., Lord Rayleigh, M.A., F.R.S., W. N. Stocker, M.A., and H. T. Wood.

Mr. C. W. COOKE read for the author, Prof. S. P. Thompson, a paper on "Permanent Plateau Films," and exhibited the process of their formation. After a brief enumeration of the various attempts made by Plateau himself, Schwartz, Mach, Rottier, and others, most of which are described in the work of Plateau, the author described his own experiments on the subject. As the result of these, he concludes that the best results are obtained by using a mixture of 46 per cent. of pure amber-coloured resin and 54 of Canada balsam, which should be heated to from 93° to 95° C. The frames for forming the films are made of brass wire 0·3 mm. in diameter, and when thicker wire is employed they are found to be irregular, in consequence of the retention of heat by the metal. The films are obtained by simply introducing these frames into the heated mixture, and they harden almost immediately on exposure to the air; but better results are obtained by slow drying in an air bath, heated up to 80° C., and allowed to cool. In proof of the toughness of the films, it was mentioned that a flat circular film 4 cm. in diameter had supported a 50 gramme brass weight at its centre.

Mr. SEDLEY TAYLOR then exhibited some experiments in illustration of a paper on the colours exhibited by vibrating liquid films which he has recently communicated to the Royal Society.

Dr. GUTHRIE exhibited a simple lecture illustration of the action of the telephone. Two similar coils of wire are placed one on the end of a bar magnet, and the other on a soft iron core. A tin disc, about 3 inches in diameter, is suspended by two threads almost in contact with one end of this latter, and when a similar disc is brought, at regular intervals, against the end of the magnet which is provided with the coil, a distinct movement of the first-named disc is observed, which can be easily increased by properly timing the movement of the inducing disc.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday, the 19th ultimo, at the Institution of Civil Engineers; Mr. S. H. Eaton, M.A., President, in the chair. Commander E. G. Bourke, R.N., J. A. Douglas, W. H. La Zouche, B.A., G. J. Pearse, W. S. Rogers, and W. Tyrer were elected Fellows, and eight candidates proposed.

The following papers were read: "Notes on the Meteorology and Physical Geography of the West Coast of Africa, from Cape Verd to the Cape of Good Hope," by Commander E. G. Bourke, R.N. This paper gives the results of the observations which the author made during the five years he was stationed on the above coast.

"On the Meteorological Observations made by the Norwegian Deep-Sea Exploring Expedition in the North Atlantic in 1876 and 1877," by Professor H. Mohn. This expedition has been organised in order to carry out for the North Atlantic and the Arctic Oceans an enquiry similar to that conducted by the *Challenger* Expedition. The vessel employed was the *Voringer*, of 400 tons burthen, and the period the summer months of 1876 and 1877. The barometrical observations were taken at first with a mercurial barometer, and afterwards with an aneroid, which was compared daily with the mercurial barometer on board. The temperature was obtained by a special screen hoisted upon the forestay. It was found that this gave very satisfactory results. The experiments conducted with a screen similar to that used by our Meteorological Office on ship-board, gave readings too high when the sun shone on it. The sling thermometer was also tried, and gave a temperature on the mean a shade below the screen in the rigging. The wind observations were taken with an anemometer, and Professor Mohn describes his own anemometer at length, and deals with its corrections in detail. The speed of the ship was determined by a special logging machine, and by this means and the anemometrical observations, the true motion of the wind was ascertained. The part of the paper which presented most novelty was that referring to the evaporation of the sea water. Two different forms of atmometers were described, both of them devised by Professor Mohn, and the theory of their action and of the errors to which the experiments were exposed are carefully considered. The paper concluded with tables of the diurnal range of the various meteorological elements for the period of observation.

Report on the "Phrenological Observations during 1877," by the Rev. T. A. Preston, M.A. As a rule the same order of flowering of plants is observed this year as in 1876, viz., that plants came into flower first in the South-West of England, and then in regular order to the North of Lincolnshire, where plants were latest in coming into flower. From the tables accompanying the report may be deduced the general state of the weather as regards temperature, and to a certain extent moisture. There is no doubt but that damp acts more powerfully than cold in retarding the flowering of some plants, and this has been particularly evident this year. The year, as a whole, has been very unfavourable to vegetation; the bitter cold of May checked the growth of plants, and by the autumn there was comparatively little new wood, and that not properly ripened.

Note on a peculiar Fog observed at Kew on October 18th, by G. M. Whipple, B. Sc., F.R.A.S.

Notes.

TELEGRAPHIC FIRE ALARMS are to be brought into use all over Paris. The alarm of fire will be given to the fire-engine stations by breaking a small pane of glass facing the streets.

THE telegraph office at the House of Commons is about to be connected to the Central Telegraph Office by a pneumatic tube. Hitherto, communication between these two places has been maintained by wire. The tube is formed of lead, enclosed in an iron pipe like those elsewhere in the city, and is of large capacity.

SIR WILLIAM THOMSON has been elected a foreign associate of the French Academy of Sciences, in the room of M. von Baer, by 27 votes out of 52. The other candidate was M. van Beneden.

A NEW company has been organised in the United States under the title of the "American Speaking

Telephone Company." It has contracted with the Gold and Stock Telegraph Company for the manufacture and introduction of telephones of the latest and most improved designs upon its numerous private telegraph lines in New York and the neighbouring cities, and elsewhere throughout the country. The Gold and Stock Telegraph Company has, by contract with the Western Union Telegraph Company, facilities for establishing such lines in all places where the Western Union Telegraph Company possesses lines.

IT is reported from America that the telephone of Mr. Richmond, of Lansing, Michigan, was tested on November 18th, through a wire between Lansing and Detroit, a distance of 230 miles, and worked very successfully. It is even said to be superior to that of Bell.

THAT eminent scientific authority *The Times*, at the conclusion of a report of a lecture on the telephone, given by Professor Barrett at the London Institution on the 27th ult., gives the following:—"Some interesting experiments were tried with the telephone at the Crystal Palace on Boxing-day. The main fact established was, that above the heads of 50,000 persons who congregated at the Palace, and the consequent noise created below, the operators at each end of the wire did not experience the slightest difficulty in carrying on a conversation with each other." This is certainly a most remarkable fact, and is likely to give the intelligent public a very clear idea of the way in which the telephone works!

MR. EDISON'S PHONOGRAPH.—The New York *Times* says that it is evident that this invention will lead to important changes in our social customs. The lecturer will no longer require his audience to meet him in a public hall, but will sell his lectures in quart bottles at fifty cents each; and the politician, instead of howling himself hoarse on the platform, will have a pint of his best speeches put into the hands of each one of his constituents. A large business will, of course, be done in bottled sermons, and many weak congregations which are unable to pay a regular pastor will be content with publicly opening a bottle of "Dr. Tyng," "Dr. Crosby," or some other popular ministerial brand, but the practice of personal preaching will be continued, since in no other way can a weekly opportunity be afforded to ladies for mutual bonnet inspection.

M. TROUVÉ has communicated to the Academy of Sciences, Paris, a plan whereby the undulatory currents produced in the line by a Bell articulating telephone may be intensified almost indefinitely. His plan is to multiply the number of vibrating diaphragms, so that the currents due to each shall unite their effects into a single undulatory current of multiplied strength. He therefore substitutes for the single diaphragm of a Bell telephone, a group of five diaphragms forming five sides of a cubical chamber, the sixth side being wanting. The mouthpiece opens into the interior of this hollow chamber lined with diaphragms. Each diaphragm is a vibrating surface, and acts independently of the rest upon its own coil and magnet. By associating all the currents produced by these magnets, a current is obtained of an intensity which is proportional to the number of magnets influenced. For the cube a polyhedron may be substituted, the faces of which are formed of an indefinite number of vibrating diaphragms, in order to obtain the desired intensity. M. Trouvé's arrangement appears to be a cluster of telephones.

M. GRAMME, the inventor of the well known magneto-electric machine, has been made a Chevalier of the Legion of Honour. Twenty years ago, M. Gramme was, we believe, an *ouvrier*.

SPECTRUM OF THE ELECTRIC LIGHT IN GASES UNDER PRESSURE.—M. Weellner finds that there are two well defined classes of effect produced on the spectrum of the electric light in gases under pressure. In the case of hydrogen, the lines or bands themselves broaden out into a continuous spectrum. With other gases a continuous spectrum shows itself between the bands, which remain as definite as before. In the case of carbon compounds, and especially in that of carbon dioxide, the brilliancy of the continuous spectrum soon becomes so great that the bands are merged in it and cannot be distinguished; in nitrogen and air, however, they can be distinguished until the pressure becomes much more considerable.

CHLORIDE OF SILVER CELLS FOR SUBMARINE CABLE TESTING.—The remarkable constancy of the electromotive force and internal resistance of these cells, eminently fits them for the purpose of testing cables. The ordinary Minotto which is used at sea is subject to slight fluctuations, either of electromotive force or resistance when in action, so that in testing a lengthy cable by its means, the variations of the current running through the cable produce inductive "kicks," or sudden swings of the galvanometer needle, which materially interfere with the taking of observations on the scale. The chloride of silver cell is very much superior in constancy to the Minotto, and little, if at all, inferior to the Clark standard element in this respect. In fact it forms a practically constant battery. It is, moreover, small and clean, and can be packed into a space less than a quarter of that required for the Minotto or other form of Daniell. A set of twenty-five, for cable testing, may easily be framed in a neat box, which can be carried by hand, and in this form they would be suitable as a portable battery for electricians at cable stations. Even for signalling purposes they would be most advantageous, especially on cables. They are somewhat expensive to set up in the first instance, owing to the silver chloride they contain, but as they reduce out pure silver which can be sold, they are not really expensive in the end. We believe that from eighty to ninety per cent. of the original cost can in this way be recuperated.

MAGNETISATION OF NICKEL.—M. Wild in a memoir to the Academy of Sciences, St. Petersburg, states the conclusion which he has arrived at from an examination of the magnetism of nickel, to be as follows:—1. Pure nickel, unlike pure iron, may acquire a considerable amount of permanent magnetism. The maximum amount of the permanent magnetism it can acquire is, however, only from one-half to one-third of that which hardened steel can receive. 2. The magnetism remaining in the nickel after the magnetising force ceases, is less permanent than in well-hardened steel; the slow and gradual loss of magnetism in the course of time, or the more abrupt loss due to heating and cooling, is proportionately greater than in hardened steel, even when, like steel, the nickel is brought by repeated warming and chilling into a certain condition of permanence. 3. The temperature coefficient of a nickel magnet when in this condition is little greater than that of well-hardened steel. 4. The temporary magnetism which pure nickel acquires is about double that of its permanent magnetism; half that of the temporary magnetism which hardened steel can take; and a fourth of that which can be developed in soft iron.

MAGNETIC ROTATORY POLARISATION.—M. Henry Becquerel has recently published a lengthy memoir on this subject. His principal results are given in the *Ann. Chim. et de Phys.* v. xiii. 5, as follows:—1. That the positive rotation of the plane of polarisation of a ray of light having a definite wave-length, in passing through the unit of thickness of a diamagnetic material under the influence of magnetism, is sensibly proportional to $n^2 (n^2 - 1)$, a function of the index of refraction, and to a factor depending on the magnetism and on the diamagnetism of the body, this factor becoming the greater in proportion as the substances are more diamagnetic. 2. That with substances chemically allied or containing the same radical, the quotient of the magnetic rotation and the corresponding value of $n^2 (n^2 - 1)$ varies very slightly. 3. That the chemical nature of the substance exerts an important influence on the phenomena, so that the several constituents of a compound may produce an independent effect. 4. That when in solution the specific effect of the molecules of diamagnetic bodies is not influenced by the concentration of the solution, while that of the molecules of magnetic bodies may be greatly affected by the closer proximity which such a concentration would cause. 5. That when the substances are very diamagnetic, the dispersion of the rays caused by the magnetic rotation is sensibly proportional to $\frac{n^2 (n^2 - 1)}{\lambda^2}$, in which expression λ is the wave-length and n the index of refraction. The original paper also deals with the theory of M. Becquerel *père*, which refers the difference between magnetism and diamagnetism to the relative strength of the magnetic energy of the bodies experimented on, and that of the medium by which they are surrounded.

ELECTRICITY FOR SLEEPLESSNESS.—That galvanisation of the head has an hypnotic effect has long been known; hitherto, however, it has not been used to counteract sleeplessness. Vigoureux asserts *(Allg. Wiener Med. Ztg.)* that he has daily obtained the finest results in this direction, and has failed only in exceptional cases, as, for instance, when sleep has been disturbed or prevented by severe dyspnœa. His method is to place the broad, flat electrodes (carbon covered with chamois leather) on both temples, and allow the current of from three—at the most, five—Trouvé's elements to pass for a half or a whole minute. When the application is made in the morning the patient experiences a more or less pronounced inclination to sleep. Occasionally the effect of the galvanisation is prolonged after the first night, for a night or two.—*Scientific American.*

RESISTANCE OF AN ELECTRO-MAGNETIC RECEIVING INSTRUMENT.—The *Philosophical Magazine* for Dec., 1877, contains a mathematical paper by Professor Clausius on "A General Theorem respecting Electrical Influence," and also an interesting investigation by Mr. R. S. Brough on the best resistance to give to an electro-magnetic telegraph receiving instrument. Mr. Brough finds that in the case of a perfectly insulated and uniform line the resistance of the receiving instrument should be one-fifth of the resistance of the line, or

where $r =$ the resistance of the receiving instrument in ohms,
$l =$ the length of the line in miles,
and $k =$ its resistance per mile in ohms,

then $r = \frac{k\,l}{5}$

Singularly enough, this is the precise value selected on experimental grounds by Professor Hughes. Taking into account the resistance of the signalling battery, which is neglected in the result just given, the proper resistance for the receiving instrument becomes

$$r = f = \frac{k\,l}{4}$$

where $f =$ the total resistance of the battery.

M. JOURDAN has lately described a new single liquid battery to the French Academy. The electrodes are zinc and black lead, and are immersed in an aqueous solution of sal-alkali. It is said that the power of the battery is superior to that of Bunsen and its constancy is very great.

TELEGRAPHIC communication between Java and Australia has been restored.

THE SOCIETY OF TELEGRAPH ENGINEERS.—The next ordinary general meeting of this society is announced to take place on the 23rd inst., when the President elect, Dr. C. W. Siemens, will deliver his inaugural address.

IN an article to the December number of the *Nineteenth Century* on "Cheap Telegrams," Sir Julius Vogel makes the following suggestions by way of improving the present postal telegraph service:

1. A revision of the charges for ordinary telegrams, to embrace a reduction in the minimum number of words, and a logical recognition of the cost of free addresses and delivery, stationery, &c. The message should be ten instead of twenty words.

2. Subject to examining the length of present messages and making allowance for increased business on the one hand, and diminished length of telegrams on the other, the scale to be adopted to be ninepence for ten words, and threepence for each five words additional, or sixpence for each message, and a halfpenny for each word in excess of the signature and addresses.

3. That free names and addresses be still given.

4. That signatures to telegrams be required.

5. That a system of cheaper telegrams to be delivered by post be adopted.

6. That in connection with it the power of registering telegrams be afforded.

7. That a telegraph money order system be established.

AT a meeting of the Mersey Docks and Harbour Board, Mr. Glynn inquired how it was that when there was bad weather, which occurred nearly every month or six weeks, there was always an interruption of telegraphic communication between Liverpool and Holyhead. Mr. Holt said that the Marine Surveyor had remonstrated with the Postal Telegraph Department. There were considerable interruptions in November and December. There was one interruption which lasted from November 27th to December 1st; and this was owing to the breaking down of a bridge, and the wires being carried with it. On the 4th, 7th, 10th, 11th, 15th, and 20th December, the stoppages were continual in the early morning, simply owing to a collection of either spray, rain, or sleet, and until the sun had dissapated this, communication could not be carried on. The Marine Surveyor gave it as his opinion that subterranean lines would be disadvantageous. The most important communication of the whole—because life might be involved—was that with Crosby Lightship, and this had been put in thorough repair. Mr. Guion pointed out that the Board had communication with Point Lynas, independent of the Post Office; and though all the wires were on the same poles, they got information through the Marine Department, when the Post Office could not give it. Mr. Trellock mentioned that they received news from Point Lynas of the loss of the *Dakota* at the Marine Office, when they could not get it through the Post Office. It was agreed that a report should be brought up on the working of the whole system.

City Notes.

Old Broad Street, Dec. 31st, 1877.

IT looks as if Mr. Pender and his friends were going to be speedily undeceived in their fancy that they have acquired an absolute monopoly of telegraphic traffic between this country and America. Perhaps, however, they will be able to explain away the fact—at least, as the statement is published in a journal by no means hostile towards the Pender clique, we conclude it may be relied upon as such—that a bill has been introduced into the United States House of Representatives ostensibly to aid in the establishment of additional telegraphic communication between the United States and Europe, and for other purposes, "which purpose is to give a very liberal charter to the American Cable Company, in consideration of the free transmission of Government messages and their preference in point of time, and a reduction of two-thirds in the present rate of tolls for the public, provided that the number of words sent by the Government shall not exceed the highest number of words sent in any one year since ocean cables were introduced." We also learn that the charter proposes *to confer the exclusive right to land cables on the American coast.* Finally, it is provided "that five years after the said cable shall have been in working order between the city of New York and England and France, the rates shall be reduced to 20 cents per word, and at the expiration of eight years to 17 cents, in twelve years to 13 cents, and after fifteen years to 10 cents per word." We are quite aware that Mr. Pender has been laying the flattering unction to his soul that we were mere alarmists, anxious only to try and bring him into disrepute. To tell the truth, we do not care a straw about Mr. Pender personally one way or the other; we do care to interest ourselves in, and have interested ourselves in, the deluded shareholders of the united companies and the public—those shareholders who were to reap a harvest by the amalgamation, that public which was, by Mr. Pender's aid, to realise the benefits of cheap telegraphy. It will now be seen by the shareholders, and by the public no less than by Mr. Pender and his friends, that we did not prophecy vain things. We knew that it was almost as impossible for the latter to secure a monopoly of cable traffic to America, as for Canute of old to stay the course of the rising tide—the wonder is that anyone else thought otherwise. The announcement we have quoted from an American contemporary has caused us a little surprise, because we scarcely expected that the inevitable consequence of the policy pursued by the united companies would so soon come to pass. But nothing else was to be expected in the long run. We did construe Mr. Pender's silence on the subject of the threatened interference of the American Government with the Direct Cable as a suspicious circumstance, and if Mr. Pender had any idea of what was likely to happen, we can readily understand why he declined to commit himself to any definite declaration. Of course, it does not follow that because a bill is introduced into the American Conference it will be passed; but the terms of the measure are such as cannot fail to command wide approval. We shall wait patiently to see if it obtains the sanction of the United States' Government. If it should be rejected, why, the evil day for Mr. Pender and those who have pinned their faith to his sleeve, will be simply postponed; while if it should, even with modifications, be accepted, then the time of tribulation will, indeed, have dawned for them. Imagine the position of the Direct Company if "the exclusive right to land cables on the Atlantic coast" be granted to some other enterprise.

By the way, what will the Globe Company do should another cable be laid across the Atlantic by an independent company? That something will have to be done in that case is obvious. We are inclined to think the Globe Company will certainly not let the shares, which, not so very long ago, were recommended as averaging the dividends and risks of telegraph investments, be depreciated still further in value without an immense effort. Will the directors issue fresh capital to poor widows who require a safe investment at 5 per cent., and buy up or amalgamate the new company with the old? We confess, absurd as it may appear, we should not be in the least astonished if, should a new company commence operations, negociations were at once set on foot by the monopoly wire-pullers with that end in view. Most people have an impression that the capital of the Anglo-American Company is ridiculously high already; but Mr. Pender and his supporters count hundreds of thousands as trifles light as air, and we dare say they have already begun to discuss the amount of fresh capital they may have to ask for. We could hardly commend such a step under any circumstances; but if the Globe Company and the companies which it has thrown its shield over get into a scrape, and investors like to assist them out of it—well, we cannot help it.

It is rather curious that the traffic receipts of the Anglo Company have, since the amalgamation, appeared to steadily increase, though, on the other hand, the traffic receipts of the Direct Company have appeared to steadily decline. Yet, before the amalgamation, the receipts of the Direct Company were increasing, and those of the Anglo Company declining. Is it possible that Mr. Pender—we really owe our readers an apology for mentioning his name so often, but it is unavoidable—intends to prove how kind he was in his terms to the Direct Company? The Anglo Company, it will be recollected, takes 75 per cent., the Direct 25 per cent. of the receipts, whatever the surplus of receipts may be over expenditure. How admirably some things are managed!

We know nothing of the Westminster Association, Limited, except that some of the individuals belonging to it must be very silly persons. The Westminster Association have forwarded to the proprietors of the Anglo-American Telegraph Company a circular urging that the reserve ought to properly bear the cost of expeditions sent out to recover cables. In other words, the members of the Westminster Association, being not unnaturally dissatisfied with the dividend paid by the Anglo-American Company, affirm that it is a great shame they should have to contribute toward the expenses of repairing their own cables. They fail to see, what everyone else of course perceives immediately, that the reserve fund of the Anglo Company is set aside, not for repairing, but for renewing cables. Whatever the Westminster Association may urge to the contrary, any expenditure incurred by the company in the way of repairs is most clearly chargeable to the current working expenses, and a demand that it should be paid from the reserve fund is either owing to impudence or to sheer ignorance. It would be as rational to argue that the salaries of some of the officials ought to be paid out of the reserve fund, as that repairing expenses—which will always occur every year—should be debited to it.

At an extraordinary general meeting of the Mediterranean Extension Telegraph Company held last week, resolutions, making alterations in the articles of association, by which the quorum for a general meeting was altered from twelve shareholders holding a thousand shares to eight shareholders holding the same number of shares, either in person or proxy, and reducing the maximum number of directors from seven to four, and the minimum from five to three, were, we learn, unanimously confirmed "without remark."

It is announced by the Eastern Telegraph Company that an interim dividend of two shillings and sixpence per share in respect of profits for the quarter ended September 30, is payable on the 14th of January; and a dividend of three shillings per share in the six per cent. Preference Shares, less income-tax, for the quarter ending December 30, will also be paid on that date. The directors of the Eastern Extension Company have declared an interim dividend for the quarter ended September 30 of two shillings and sixpence per share, or at the rate of 5 per cent. per annum.

We do not, as a rule, concern ourselves in the movements of Tramway Companies, which are somewhat beyond the scope of this journal. But the attempt now being made by the North Metropolitan and London General Omnibus Companies to unite deserves a passing word of notice. It is evident to all impartial observers that such a union would only be injurious to the interests of the public, unless both of the companies pledged themselves to certain things they are unlikly to agree to. For our own part, we are dubious whether amalgamation is seriously intended. There have recently been so many utterly unfounded rumours of amalgamation, that we are disposed to fancy it is a case of the Manchester, Sheffield and Lincolnshire Railway over again. At any rate, investors should, at this juncture, be very careful in purchasing shares in either of the companies in question, no matter at what price they are quoted in Capel Court.

General Science Columns.

THE ANNUAL GENERAL MEETING OF THE INSTITUTION OF CIVIL ENGINEERS.—The annual general meeting of the Institution was held on Tuesday, the 18th of December, for the purpose of receiving the report of the Council, and electing the president, vice-presidents, and other members of Council for the ensuing year. The report referred to the proposal, made in the report of the previous year, to separate the professional from the non-professional associated by creating a new class, under the title of "Associate Member," for those professional associates who were not qualified for the higher class of "member." This proposal, however, did not meet with the approval of a large number of associates who would have been affected by the change; and at a special general meeting held last April, after a long discussion, it was decided to abandon the proposal. The Council, however, considering that the matter was left in an unsettled and unsatisfactory state, and that the associate class should not remain in its present mixed form, has now proposed to create a new class with the title of "Senior Member" or "Fellow." The professional associates would, according to this proposition, be transferred to the class of "Member," and the new class be reserved for the senior members of the society. The further consideration of this proposal is reserved for a special general meeting of members and associates. The only method by which we think the proposed change could be made acceptable to the existing members would be by transferring the whole of the present members into the new class; the title of member being conferred upon all the present professional associates, who could be transferred when properly qualified, to the higher class. The numbers of the several classes on the 30th of November, 1877, were:—Honorary members, 16, members, 925, associates, 1,670, and students 448, together 3,059, as against 2,844 at the same date last year, showing an increase at the rate of about 7½ per cent. The income of the Institution has nearly reached £10,000 a year; the "minutes of proceedings," of which four volumes are now annually published, cost in the past year nearly £5,200. The following is the list of gentlemen elected to fill the several offices in the Council for the ensuing year:—Mr. John Frederic Bateman, F.R.S., President; Mr. J. Abernethy, Sir W. G. Armstrong, C.B., F.R.S., Mr. W. H. Barlow, F.R.S., and Mr. J. Brunlees, Vice-Presidents; Mr. W. Baker, Sir J. W. Bazalgette, C.B., Mr. F. J. Bramwell, F.R.S., Mr. G. B. Bruce, Sir John Coode, Mr. W. Froude, M.A., F.R.S., Mr. G. F. Lyster, Mr. W. Pole, F.R.S., Mr. C. W. Siemens, F.R.S., Mr. D. Stevenson, F.R.S.E., Sir Jos. Whitworth, Bart., F.R.S., and Mr. E. Woods, members; and Colonel H. Hyde, R.E., Mr. J. P. Knight, and Major-General Scott, C.B., R.E., F.R.S., associates. In former years it has generally been the custom to re-elect all the old members of Council, and only add new members as vacancies occurred, but in this election this custom has been departed from, and though only one vacancy had occurred, owing to the President, Mr. G. R. Stephenson, having completed his term of office, four new members have been elected in addition to the three associate members who change every year. Though a change in a custom may seem hard upon those who are the first sufferers, yet it is well that the members of Council should not regard their re-election as a matter of routine; and the discretion exercised by the members should ensure the election, without delay, of eminent members when they are put forward, which will tend to promote the efficiency of the Council and confer additional distinction on those elected.

IN THE NEW PYRO-HYDROGEN LIME LIGHT, made by the Sciopticon Company, coal gas and common air mingle on the lime disc; prepared oxygen not being required. This is an important advantage, and the new light is likely to prove a convenience to those using Sciopticon or magic-lanterns, and to photographers in such operations as enlarging, copying, &c.

IN support of the germ theory of zymotic diseases, such has cholera and typhus, it has recently been found by M. Bollinger that a certain incurable disease which affects the mouth, lymphatic glands, and stomach of cattle, is caused by a fungus which resembles common green mould.

PHOTOGRAPHING BY ARTIFICIAL LIGHT.—Mr. Van der Weyde, an American artist, has invented a means of enabling photographic portraits to be taken without the use of solar light, which is admitted on all hands to give highly satisfactory results, and which cannot fail to be of great service in our country where pure white daylight is so rare and inconstant. It is well known that the lime, magnesium, and electric lights, when employed directly as illuminators of the portrait model, produce photographs in which the light and shade are too strongly contrasted. This is due to the artificial rays radiating directly from a single point, whereas, solar light is diffused in the atmosphere. The diffused white light reflected from a cloud surface is regarded by photographers as a superior kind of light; and it is this source that Mr. Van der Weyde's artificial arrangement most resembles. A powerful electric beam, from a Siemens' magneto-electric machine, is thrown upon a concave parabolic mirror and reflected in parallel rays, which are then refracted to a cone of rays by a large lens. In this cone of rays, at or near the focus, the model sits, and excellent portraits can be obtained by an exposure of less than thirty seconds. By this method the light seems to become diffused, so that sudden light and shade is avoided; the portraits produced being soft and delicate in quality and highly natural in artistic effect.

SENSITIVE REACTION OF ALUMINA AND MAGNESIA BY SPECTRUM.—M. H. W. Vogel finds that when a small quantity of an aluminum salt is added to a solution of purpurine in water very slightly alkalized by ammonia, the liquid takes a beautiful red tint and offers two strong absorption bands between the lines D and E and B and F; often a third more feeble band is noticeable towards F. If the concentration of the liquid is too great these bands unite into a single one.

To detect aluminum, to 2 cubic centimetres of the solution containing aluminum, which ought to be neutral, add 3 drops of an alcoholic and saturated solution of pure purpurine, and then a drop of ammonia diluted with four volumes of water.

In presence of very small quantities of ammonia, less than one-tenth milligramme, the absorption bands shew themselves after several minutes. One drop of dilute acetic acid is without influence on the intensity of the bands; an excess of acetic acid enfeebles them without causing them to disappear altogether; an excess of tartaric acid or of a mineral acid destroys them, but they reappear when the liquid is neutralised.

Magnesia offers with purpurine a reaction quite analagous to that which alumina gives, but the bands which it furnishes, disappear under the influence of the least quantity of free acetic acid.

Magnesia and alumina can be detected by this reaction even if they are in presence of organic matter, or of ammoniacal or alkaline salts. Salts of iron and zinc forbid the reaction and must therefore be eliminated. This can be done by adding to the solution an excess of tartaric acid, then ammonia, and at last sulphhydrate of ammonia; the iron and zinc are precipitated, the filtered solution supersaturated with chlorhydric acid boiled, filtered a second time and neutralised, is ready for the direct test for alumina and magnesia.

In presence of certain salts the purpurine precipitates itself in the state of alumina or magnesium flakes and escapes the examination of the spectroscope; in this case the flakes are separated by infiltration, dissolved in acetic acid and neutralised by ammonia.

M. Vogel also finds that purpurine is often adulterated with cochineal which is deleterious to the reaction. In order to detect cochineal it is sufficient to agitate the aqueous solution of the dye with ether. The ether engages all the purpurine, whilst the carmine remains in the aqueous solution.

M. Von Lepel has confirmed in general these results of M. Vogel, and has added some new observations of his own. He points out that the disappearance of the magnesian bands under the influence of a small quantity of acetic acid, is the simplest means for distinguishing the bands of alumina.

He finds that large quantities of lime exercise a disturbing influence on the reaction, for the lime salts gives in presence of water two absorption bands, large but feeble, separated by a clearer part situated towards E *b* and capable of masking the magnesian bands. Also a mixture of equal parts of magnesia and lime gives a spectrum at every point analogous to that of a mixture of alumina and magnesia. The major part of the lime ought therefore to be eliminated, and this can be done by precipitating by Seignette's salt the liquid already mixed with purpurine, and examining it directly by the spectroscope, when the precipitate has settled, which takes place after some minutes. When the quantity of lime is less than 0·0008 gramme per cubic centimetre of the solution, it exerts a good rather than a bad influence on the test.

By means of the spectroscope, M. Von Lepel has been able to detect small quantities of magnesia in the watery humour of the eye, in whey, in the urine of man, and different domestic animals, the bile of cattle, the stems and leaves of plants, the juice of the apple and pear, in flax seed, &c.—*Deutsche Cehmische Geselschaft.*

THE Royal Society has awarded a Royal Medal to Mr. Frederick Augustus Abel, F.R.S., president of the Society of Telegraph Engineers, for his physico-chemical researches on gun-cotton and explosive agents. The Davy Medal, a bequest of Sir Humphry Davy, and now given for the first time, was awarded Messrs. Kirchoff & Bunsen for their researches and discoveries in spectrum analysis.

CESSPOOLS.—Dr. F. Erisman has found eighteen cubic metres of excrement, such as is ordinarily met with in cesspools, to give off in twenty-four hours

11·144	kilogrammes of	carbonic acid gas,
2·040	"	ammonia gas,
0·033	"	sulphuretted hydrogen gas,
7·464	"	carburetted hydrogen gas;

making in all 20·681 kilogrammes, or about twenty cubic metres of unbreathable gas. Dr. Erisman deems copperas and sulphuric acid the best disinfectants. Herr Ecktein considers chloride of lime the most powerful deodoriser for cesspools, and proposes to use it wrapped in parchment paper, whereby its action is prolonged. He considers copperas and sulphuric acid as defective, because of their brief action, which extends only over one day or two, whereas chloride of lime operates for a week. He found liquid sulphuric acid to act almost immediately, but it was oppressive to breathe, and after twenty-three hours it was exhausted. A kilogramme of copperas in a bag of parchment paper only began to act after two hours, but continued effective for three days. On the other hand, a kilogramme of chloride of lime in parchment paper acted powerfully for nine days. The place operated upon was a public privy used daily by at least a hundred persons. Herr Ecktein regards chloride of lime and sulphuric acid as the most powerful deodorisers known.

PRINTING types of hardened glass have been found to work admirably on the revolving press with continuous paper, and may possibly come into general use.

ANCIENT RUINS IN COLORADO.—Dr. Hayden, of the United States Geographical and Geological Survey, has recently discovered some very interesting ruins of a vanished people in the Valley of the Animas, South-western Colorado. The finest of these ruins and the most perfect are situated about thirty-five miles below Animas City in a large valley on the west side of the river. This valley has at one time been covered with buildings of all sizes, the two largest being 6,000 by 300 feet, standing about 300 feet apart, and exactly similar. They are built of small blocks of sandstone, laid in adobe mud, the outer walls being four feet, and the inner walls from a foot and a half to three feet thick. In the lower storey of the outer walls are found port-holes a foot square. Several rooms are still left, and walls reaching four stories high are still standing. About the second storey on the west side there was once a balcony along the entire length of the building. No signs of a door are visible in the outer walls, and the entrance must have been from the roof. Inside there are passages from room to room. Most of the rooms are small, from 8 by 10 to 12 by 14 feet, the doors being 2 by 4 feet. The lintels over the doors and portholes are made of small cedar poles, two inches wide, placed across, on which the masonry rests. The joists supporting the floor are of cedar, about 8 inches thick, 20 to 50 feet long, and about 3 feet apart. A layer of small round poles has been placed across the joists, then a layer of thinly-split cedar sticks, then about 3 inches of earth; then a layer of cedar bark, then another layer of earth, and finally a carpet of some kind of grass. The rooms that have been protected from exposure are whitewashed, and the walls are ornamented with drawings and writings. In one of the rooms the impression of a hand, dipped in whitewash, on a joist, is as plain as if it had been done yesterday. In another room there are drawings of tarantulas, centipedes, horses, and men. Human bones have been found, bones of sheep, corn-cobs, raw hides, and various kinds of coloured pottery-ware. Portions of the buildings show that they have been destroyed by fire, the timbers being burned and the roofs caved in. The stone which these buildings are built of must have been brought a long way, as nothing similar can be found within a radius of twenty miles. The timber used is all of cedar, now only found twenty-five miles off. Old ditches and roads are to be seen in every direction. The Navajo Indians say in regard to these ruins, that their forefathers came there five old men's ages ago (500 years), and that these ruins were here, and the same then as now; and there is no record whatever of their origin.

BOILER EXPLOSIONS BY DECOMPOSITION OF STEAM.—At the recent meeting of the American Academy of Sciences an apparatus was shown at work which proved that steam might be decomposed by simple heat into the constituent gases of water—oxygen and hydrogen. The heat employed was a little over ordinary redness, but did not reach whiteness. This experiment is of the highest value, as illustrating a possible cause of boiler explosions. The apparatus was very simple—a flask in which water was heated, a tube conveying the steam into a closed platinum crucible, where it was again heated by a spirit lamp, a tube thence carrying the super-heated steam and the liberated gases to an ordinary pneumatic trough, where the mixed gases were collected in a test tube, while the steam was absorbed. At the conclusion of the experiment the gases thus collected were exploded by a lighted match, showing beyond question that they were the components of water. The experiment indicates that this explosive mixture of gases may be formed in a steam boiler. But it can only result from the most culpable carelessness. The boiler must, at least in part, be raised to a full red heat. Then cold water must be injected, for so long as steam and gases are mixed the latter cannot explode. The injection of water must condense the steam in the boiler before it cools the red-hot iron. All these conditions being fulfilled, an explosion of the gases may take place.—*The Polytechnic (American) Review.*

PHOTOGRAPHING IN NATURAL COLOURS.—Herr Joseph Albert, the eminent photographer of Munich, is said to have accomplished this crowning problem in photography by a combination of the ordinary photographic process with his photographic printing-press. The finest shades of colour are said to be faithfully reproduced without any resort to the brush. Three negatives are taken for each object, and finally blended together. The first negative is taken on a plate chemically prepared to receive only the yellow tints of the object; this is then passed through a printing-press, which has its roller dressed with yellow colouring matter, and a print showing only the yellow portions of the object is the result. A second negative is taken with the blue light from the object, and printed off by a second press having a blue roller. A third negative is taken with the red light from the object, and similarly printed off in a press having a reddened roller. The three images so obtained are then printed on the same plate, when the colours blend, producing the natural tints and shades of the object.

VOLATILISATION OF LIQUIDS IN A GAS.—M. Kirchman has observed that the volatilisation of certain volatile substances is retarded or forbidden in an atmosphere of carbonic acid, whilst others become more volatile in this gas. Camphor, chloroform, and sulphuret of carbon are hardly volatilised at all in carbonic acid. Ether, ethylic, methylic, and amylic alcohols, as also water, are more volatile in carbonic acid than in air. If a rapid current of carbonic acid is directed over the surface of ether, the exterior of the vessel holding the ether is covered with a coat of frost, which does not appear when a current of air is employed. Alcoholic ether is rapidly deprived of ether by a current of carbonic acid gas. In general, dry carbonic acid furnishes an excellent means for separating essential oils from the water which accompanies them in their extraction.

WHITENING OF LAC.—The following account of Kressler's method of whitening lac, as modified by Sauerwein, is given by *Dingler's Polytechnischer Journal*. Ten parts of pounded lac are dissolved by heating, with four parts of crystallised soda, in 120 to 150 parts of water in a copper basin, and the violet solution (the colour of which, according to Marquart and Esenbeck, is due to a colouring principle analagous to carmine) is filtered in a wooden vessel through linen. Into this solution is then filtered another, formed by adding ten parts of chloride of lime (containing about 30 per cent. of chlorine) to a solution of ten or twelve parts of crystallised soda in 200 parts of water. To the mixed solution is added with care some cold chlorhydric acid, diluted, until little lumps of lac begin to precipitate; a small quantity of acid generally suffices. At the end of two or three days the whitening is complete, and the lac is then to be precipitated by adding concentrated chlorhydric acid. If the lac is tolerably pure, the white precipitate can be immediately reunited on a piece of coarse linen, washed several times, and melted. When the lac is impure it must be allowed to stand several hours in the liquid along with the chlorhydric acid. The chlorine set free acts very energetically; nevertheless, it is preferable to allow the solution of chloride of lime to act on the alkaline lye. When the finely-divided lac remains a long time in the acid solution of chlorine it becomes brittle, and does not spread well. The precipitated lac is put into boiling water, which softens and permits it to be moulded; it is at first porous and opaque, but on warming it several times, and kneading and flattening it, a silky lustre soon begins to appear.

ARTIFICIAL OPAL.—To prepare artificial opal, M. Monnier takes a thick solution of silicate of soda, and places upon it a very dilute solution of oxalic acid. By endosmose the two liquids slowly mingle, oxalate of soda being produced and silica set free. But instead of taking the gelatinous form which it ordinarily assumes after a quick double decomposition, the silica deposits itself on the walls of the vessel in masses which have a density and rigidity like natural opal. On substituting sulphate of nickel for the oxalic acid, M. Monnier obtained a green opal which appeared analagous to the silicious mineral, in which nickeliferous ore is found. In treating by the same process the sulphate of alumina by a solution of ammonia, a very hard hydrate of alumina was obtained, which adhered rigidly to the walls of the vessel in which it was produced.

PROFESSOR TYNDALL ON GERMS.—Dr. Tyndall, in a recent lecture at the London Institution, Finsbury Circus, stated that he had forwarded sixty hermetically sealed glass flasks, containing infusions of cucumbers, turnips, beef and mutton, to the Alps, and on arriving there, he had found six of the infusions muddy with bacterial life, while the rest remained clear. On examining these six tubes he found the glass broken, whereas the others were intact. He was of opinion that germinal matter had entered the six broken flasks with the air. In order to see whether the air itself could not produce germinal energy in the infusions, he exposed twenty-three open flasks to the air of a hay-loft, and twenty-seven to the pure air of the mountains. At the end of three days, twenty-one of the twenty-three left in the hay-loft were found to be crowded with infusorial life, while not one of the twenty-seven left in the mountain air showed signs of life. He was of opinion that it was not the air, but something in the air which produced the life observed; and that if an infusion could be exposed to sterilised, moteless air, it would never putrify, nor would meat so heated ever putrify. It is supposed by some that air sterilised by heat would be insufficient for life. Dr. Tyndall has invented a simple apparatus by which air sterilises itself. It consists of a box with glass panels, the inside being rubbed with glycerine. The air is admitted into this box, and the particles in it fall by gravitation and stick to the glycerine, so that in time a condensed beam of light shows that the air is optically pure. For more than a year upwards of fifty infusions had been exposed to the air in this apparatus, and they were as sweet and transparent as at the time they were introduced, while similar infusions, exposed to ordinary air, were in two days swarming with bacterial life. Dr. Tyndall also showed that a mineral solution containing all the materials necessary for building up bacterial creatures could not be fertilised by the eggs of germs, such as float in the air, or adhere to hay, but was capable of being inoculated by live infusoria from infected solutions. On the other hand, vegetable infusions, such as turnip water, could be fertilised both by floating air germs or eggs, and by the living infusoria. Dr. Tyndall is of opinion that the mineral solution can feed the infusorial "chick," but cannot hatch the egg. The living bacteria are very sensitive to heat, whereas the eggs are hard and dessicated, and will germinate after eight hours boiling. Dr. Tyndall killed sterilised infusions by heating them from time to time as the eggs developed into living bacteria, until there were no more left.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your review of "The Application of Electricity to Railway Working," by W. E. Langdon, we notice you mention Walker's, Spagnoletti's, Siemens' and Preece's systems of block telegraphs; but totally ignore Tyer's. As this latter system is more extensively adopted in this country than all the others put together, we can only infer that your reviewer was unacquainted with their existence; we beg, therefore, to hand you a list of Railway Companies who have adopted Tyer's apparatus, and to inform you that considerable extensions of the system are being constantly made, and in some cases to the displacement of other apparatus mentioned in your review.

We trust to your sense of fair play to insert this communication, in order that Mr. Langdon's valuable work may in its review be as impartial as the author in his text.

Faithfully yours,

Dec. 18th, 1877. TYER & COMPANY.

[WE are sorry that Messrs. Tyer's system should have been omitted in the review referred to; the omission was quite unintentional. We congratulate Messrs. Tyer on the success which they have attained.—EDIT. TEL. JOUR.]

SIR,—Will you have the kindness to inform me if a pamphlet regarding the telephone has appeared lately? If so, you will oblige me by replying to this question in your next number. The extracts in your journal give me the desire to have a more detailed account.—Your obliged servant, PAUL ARNAUNE,

Employé du Télégraphe, Toulouse.

[We understand that a full description of the progressive steps by which the present form of Professor Bell's telephone was arrived at, will be published in the forthcoming quarterly number of the "Proceedings of the Society of Telegraph Engineers," which you will be able to obtain at Messrs. Spon, Charing Cross, London. We are not aware that any pamphlet or book has yet been published on the subject.—EDIT. TEL. JOUR.]

BARRAUD & LUNDS, 41, Cornhill, London, E.C.

GREENWICH MEAN TIME.

A CONTRACT has been entered into with the GENERAL POST OFFICE for the erection and continued extension, as required, of a GREENWICH MEAN TIME WIRE for LONDON, whereby in connection with the above Patent, any existing Clock, or Clocks, in Institutions, Offices, Private Residences, &c., can, at a SMALL INCLUSIVE CHARGE, be kept to UNVARYING TRUE TIME.

This System is now in operation at the following eminent Institutions, Companies, and Private Firms.

GREAT EASTERN RAILWAY.
BANK OF ENGLAND.
STOCK EXCHANGE.
WOOL EXCHANGE.
LLOYD'S.
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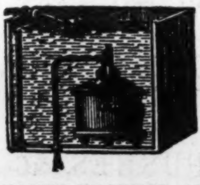

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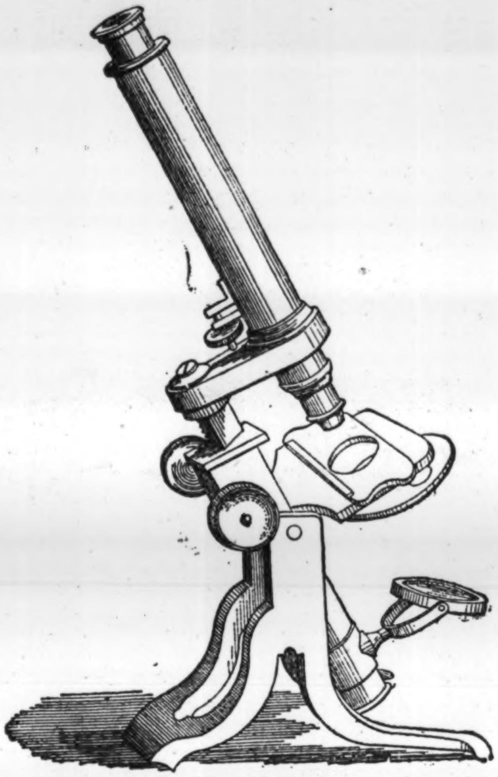

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